The vegetation of old-fields in Transkei

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The aim of this paper is to identify, classify and describe plant communities on abandoned, formerly cultivated, old fields in the former Transkei (Eastern Cape Province) and to derive hypothetical succession pathways. Forty two relevés, made in representative areas with abundant old-field lots, were classified and ordinated using standard methods of numerical vegetation data analysis. Three new associations were recognised, namely the *Richardio brasiliensis–Eragrostietum planae*, the *Trichoneuro grandiglumis–Aristidetum congestae* and the *Tageto minutae–Cynodontetum dactyli*. Within the *Tageto minutae–Cynodontetum dactyli*, two new sub-associations were recognised, namely *cyperetosum esculenti* and *typicum*. The most important coenocline spanning the young *Tageto minutae–Cynodontetum dactyli* and the old *Richardio brasiliensis–Eragrostietum planae*, correlated with the age of old-fields. We postulate that this coenocline might represent the main succession trend within the mesic old fields in Transkei. The *Trichoneuro grandiglumis–Aristidetum congestae* characteristic of dry sandy soils does not participate in this cline.

Keywords: abandoned land, associations, ordination, plant communities, succession syntaxa.

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Introduction

This study forms part of a phytosociological research programme under the Grassland Biome Project (Mentis & Huntley 1982; Scheepers 1987), with the ultimate aim of a phytosociological and syntaxonomical synthesis of the vegetation of the Grassland Biome in South Africa. Although several regional phytosociological studies have been conducted in the Grassland Biome (Turner 1989; Kooij 1990; Du Preez 1991; Matthews 1991; Breytenbach 1991; Malan 1992; Smit 1992; Bezuidenhout 1993; Coetzee 1993; Fuls 1993; Eckhardt 1993; Myburgh 1993; Burgoyne 1995), not all areas have yet been surveyed. As knowledge about vegetation is important for conservation and planning purposes (Bredenkamp & Theron 1976), vegetation survey is regarded as a prerequisite for the compilation of land-use management plans.

Little is known about the vegetation in the north-eastern part of the Eastern Cape Province, the area formerly known as Transkei. For this reason a comprehensive phytosociological research project aimed at the grassland vegetation of this area was initiated. Grasslands of Transkei, as in parts of Kwazulu-Natal, are often of secondary nature (Moll 1965; Rivers-Moore 1997), or they have resulted from vegetation regeneration of many old fields (abandoned, formerly cultivated field lots). Old abandoned fields cover a considerable area in Transkei, as a result of the traditional way of living, where each homestead used a designated portion of arable land on which to cultivate their crops (McKenzie 1984). Often these lands were left fallow after having been cultivated for some years. This resulted in a landscape mosaic of patches of secondary vegetation varying in age and dominated by various grass species, as well as *Hyparrhenia* dominated grassland (Moll 1965).

The aim of this research was to identify, classify and describe the vegetation types in the Transkeian old-fields habitats, and to detect coenoclines which might be suggestive of successional relationships among these types.

Study Area

Transkei is the area situated in the Eastern Cape Province (Republic of South Africa) between 30–33°S and 26°45' and 30°15' E. In the former political era of South Africa it used to be an 'independent' homeland for mainly Xhosa people. Transkei borders on the Kingdom of Lesotho in the north and the Indian Ocean in the south-east. In the north-east it borders on KwaZulu-Natal and in the north-west and in the west on the Eastern Cape Province proper. Since 1994 it has been part of the Eastern Cape Province.

The climate of Transkei varies from humid sub-tropical at the coast, to humid sub-tropical lower montane further inland. Climatic data for Transkei are very scarce, nevertheless existing information is sufficient to describe the climate in general (McKenzie 1984). The annual rainfall varies inland from 500 to 1400 mm and in the coastal zone from 800 to 1 400 mm. There is a decline in rainfall from east to west (from the coast to the border with Lesotho) and from north to south. A zone of low annual rainfall is, therefore, found in the south-western part of Transkei. River valleys with Valley Bushveld (Acocks 1988) are much drier, but are excluded from this research. Abundant rainfall makes Transkei generally favourable for agriculture compared with the rest of southern Africa as only 10% of this area receives less than 750 mm rain per year. Inland (Cala; 1 300 m above sea level) a mean summer daily maximum of 26.9°C was measured, whereas the mean winter daily temperature was 3.6°C. Altitude is important, as higher inland localities have lower average temperatures. The annual frost free period is 365 days along the coast, but is on average only about 240 days on the plateau.

Wood and van Schoor (1976) produced one of the few generalised soil maps of Transkei identifying seven soil types. The old fields are mainly situated on five of these types: red and yellow/brown apedal soils with an orthic epipedon, duplex soils, partially hydromorphic soils, weakly developed soils and lithosols. The soil types, mapped in the central zone, are mainly lithosols. Duplex soils and partially hydromorphic soils occur on the irregular undulating lowlands with hills, while on the undulating,

hilly terrain, the soils are mainly red and yellow/brown apedal soils with an orthic epipedon or weakly developed soils. The duplex soils, situated on the higher plateau just below the great escarpment in the north of Transkei, are highly leached. At the minor escarpment the dominant geological formations, mainly shales and sandstones of the Ecca and Beaufort series, weather to form deep lateritic soils. Cultivated topsoils erode easily, exposing the subsoil, which becomes subject to heavy erosion. The great river valleys were mapped by Wood and van Schoor (1976) as shallow and stony lithosols. They are able to store water, but drainage is poor and this leads to over-saturation. The soils, formed on the Natal group sandstones, have a poor moisture holding capacity and are generally of low nutrient status.

The geology includes layers of glacial deposits, sandstone, mudstone, and shales intersected by dykes and sheets of doleritic and intrusive rocks. Dolerite, which occurs in small patches throughout Transkei, but mainly in the north, erodes to a more fertile soil with good drainage (Wood & van Schoor 1976).

Transkei has been settled since the Iron Age (McKenzie 1984). In the traditional way of living, the villages were built close to the rivers and each homestead used a designated portion of arable land on which to cultivate their crops. All the land was tribal at that stage. When the groups became too large, or the people withdrew their support from the chief, fission and migration to a new location followed. After the annexation of the territory by the European settlers at the end of the 19th century, great changes took place. Borders were fixed and suitable arable land became even more scarce. With the growing population, more land had to be ploughed every year to satisfy the needs of the population.

Continued demand for arable land has resulted in the extension of the cultivated areas at the expense of the grazing areas. These two factors played an important role in creating the problems of overgrazing and erosion seen today (McKenzie 1984).

The recent map of the vegetation of South Africa, Lesotho and Swaziland (Low & Rebelo 1996) shows that the grassland vegetation of the Transkei relevant to this study consists mainly of three vegetation types:

Moist Upland Grassland

This grassland vegetation is located at altitudes between 600 and 1 400 m. It occurs from the Drakensberg foothills and is found extensively over Transkei bordering on the afromontane forest in valleys and kloofs. The vegetation is a dense grassland with *Themeda triandra, Heteropogon contortus, Tristachya leucotrix, Eragrostis curvula* and *Elionurus muticus* as the most conspicuous grass species (Bredenkamp *et al.* 1996). Often, in the north, *Hyparrhenia hirta* and *Sporobolus pyramidalis* become dominant. The most important herbaceous species include *Alysicarpus rugosus, Aster bakerianus, Berkeya onopordifolia, Conyza obscura, Corchorus confusus, Cucumis hirsutus, C. zeyheri, Gomphrena celosioides, Helichrysum coriaceum, H. rugulosum, Kohautia cynanchica, Phyllanthus glaucophyllus, Richardia brasiliensis, Spermacoce natalensis, Tephrosia macropoda, Tephrosia multijuga* and *Walafrida densiflora*. In places dominance of *Elionurus muticus* is another striking feature of this grassland.

Disturbed (ploughed, overgrazed, degraded) sites are often found within this region, indicating the secondary status of many of the representative plant communities (Bredenkamp *et al.* 1996). According to Acocks (1988) these Moist Upland Grassland are Highland/Döhne Sourveld, Southern Tall Grassland and Highland Sourveld to *Cymbopogon-Themeda* Veld Transition.

Coastal Grassland

This grassland supports a high number of endemic plant species that suggests a long stable existence as a climax grassland community (Lubke *et al.* 1996). This area is presently seen as a very important centre of endemism, seriously impacted by forestry and agriculture and needs to be conserved. Dominant species in this vegetation include *Cymbopogon excavatus, Diheteropogon amplectens, Eragrostis plana, Heteropogon contortus, Hyparrhenia* sp., *Imperata cylindrica, Sporobolus nitens, Stenotaphrum secundatum, Themeda triandra* and *Tristachya leucotrix*. Herbaceous plants are also very common (Lubke *et al.* 1996).

The old fields found within this vegetation type are located in Pondoland Coastal Plateau Sourveld and 'Ngongoni Veld types (Acocks 1988).

Short Mistbelt Grassland

Although Short Mistbelt Grassland (Granger & Bredenkamp 1996) is not widely distributed in Transkei, (Low & Rebelo 1996), patches of this grassland type were encountered during this survey. Normally this vegetation should be dominated by *Themeda triandra*, but at the sites disturbed by intensive agriculture *Aristida junciformis* has become dominant.

Methods

Forty two relevés were compiled on old fields in the study area (Figure 1) during January 1997. Because of limitations imposed by the local infrastructure almost all relevés were compiled along the roads, although always more than 200 m from the road itself. The Braun-Blanquet (1964) scale, extended by Barkman *et al.* (1964) was used to estimate the cover and/or abundance of all species in the sample plots. Details of the size of the sample plots, location and other features are given in Appendix 1.

Environmental and typographical data on latitude and longitude, topographical position, altitude, aspect, slope, soil colour and structure, soil depth, rockiness, grazing pressure and estimated age of the old-fields were also recorded.

The phytosociological relevés were entered into a data-base, using the package TURBO(VEG) Version 9.42 (Hennekens 1996b), whereby the cover/abundance values were transformed into percentages as follows: r = 1%; + = 2%; 1 = 3%; 2m = 4%; 2a = 8%; 2b = 18%; 3 = 38%; 4 = 68%; 5 = 88%. These percentages were transformed into an ordinal scale according to Van der Maarel (1979). A selection was made from the 57 relevés to improve the homogeneity of the data set. The outliers, because they represented rare, or undersampled, communities were disregarded at this stage. The classification of the relevés was made using TWINSPAN (Hill 1979) and

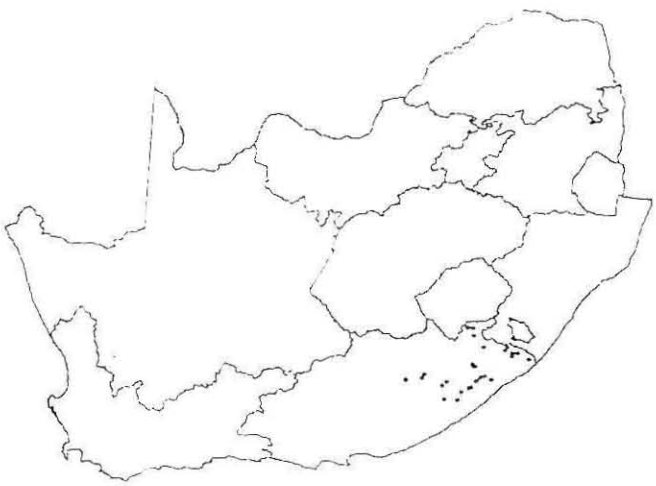

Figure 1 The localities of the phytosociological relevés used in this study.

Table 1 Plant communities of old fields in Transkei. 1: *Richardio brasiliensis–Eragrostietum planae*, 2: *Trichoneuro grandiglumis–Aristidetum congestae*, 3: *Tageto minutae–Cynodontetum dactyli*, 3.1: *cyperetosum esculenti*, 3.2: *typicum*

Relevé no.	1111111111222222 22223 33333 33334
	12345678901234567890123456789012345 67890 12345 67890
Plant communities:	11111111111111111111111111111111111 22222 33333 33333
	11111 22222
Species group A	
Eragrostis plana	.b1aa4+3a34413b43+a3b1133|.....|+..3.|....b
Richardia brasiliensis	a..1ab43bb3333a5+a.31.+..|.....|.1.a+|.+1.+
Microchloa caffra	a3....+.+.+1b.+...b.....|.....|.....|.....
Eragrostis capensis	.+...1.++.+.....+.+..+...|.....|.....|.....
Kyllinga sp.	.....+.1b.+1.....1.1+...1|.....|...+.|.....
Diclis reptans	.....+.+....+....+++..+.+|.....|...+.|.....
Paspalum dilatatum	........1.+....a.1..+.++a|.....|...a.|.....
Helictotrich turgidulum	.....1a...+....+.+.1..+..|.....|.....|.....
Polygala ohlendorfiana	.......+..++...+...++.+..|.....|.....|.....
Sonchus wilmsii	....+........++..+..3.+..|.....|.....|.....
Abildgaardia ovata	+1.....1..a....+.....|.....|.....|.....
Themeda triandra	.a.....+..+.....b...+.|.....|.....|.....
Helichrysum aureonitens	++.....1...+1.....|.....|.....|.....
Zornia capensis	......+m1.....+.....|.....|.....|.....
Oxalis depressa	.....+...+.....+.....|.....|.....|.....
Spermacoce natalensis	.....+++.....|.....|.....|.....
Species group B	
Aristida congesta	..+.3+..1.....++...|b.3bb|.+...|a....
Trichoneura grandiglumis	..1.....|.1+11|.....|.....
Felicia muricata	+.....|r..3a|.....|.....
Eragrostis lehmanniana	+.....|+.aa.|.....|.....
Walafrida densiflora	..+.....|+.++.|.....|.....
Species group C	
Cynodon dactylon	.+3+a.11a+.1+.+...b14.3+b|33aa.|33b43|33534
Tagetes minuta	.....++.....+.....|1....|bab1b|b3mmm
Bidens pilosa	.....+.....+.....|.....|.ma.b|.111m
Conyza bonariensis	.....+..+|.....|+a3.a|1.1r.
Schkuhria pinnata	.....|+....|m..++|+.mb.
Pseudognaphalium luteo-alb	.....++|.....|..m+m|.+.1.
Xanthium strumarium	.....+.....|m....|..+..|+.+m.
Arctotis arctotoides	....+.....|.....|1+...|a+...
Sonchus dregeanus	.....+.|.....|..+.+|..+.+
Species group Ca	
Cyperus esculentus	.....+....+..|.....|+1ab.|.....
Cirsium vulgare	.....|.....|rr++.|....+
Stenotaphrum secundatum	.....|.....|1..+1|.....
Senecio inaequidens	.....+.....+.....|.....|.+1.+|.....
Galinsoga parviflora	.....|.....|m.a.a|.....
Other taxa	
Sporobolus africanus	.++1++aaa1.+1.b..+ma3a1..|1....|.....|.++.a
Lobelia erinus	++1.+m+.+.+....+++..+1+.+|.....|.r...|.1..+
Eragrostis curvula	1.....+.1.11...++..a31+3|.+.+.|.+...|.....
Hyparrhenia hirta	3.+.b.1aa....+a..a....+3.|.+.+.|.+...|....+
Hypochaeris radicata	..ba++.....1...+...a..1|r...+|r1+.+|++.ra
Anthospermum rigidum	+1.....+..+.|..b.+|.....|.....
Melinis repens	...b.....a....|.....|.1...|.++.b
Commelina africana	..+.++.1.+...+.....+.....|+....|.r+..|+....
Centella asiatica	....+b+1.+....+++1.++..+.|.....|...a.|..b..
Cotula hispida	.....+1.++.+.....|.....|+..+.|+....
Wahlenbergia stellarioides	....+++1+.....+..a..|..1..|..1..|.+...
Oxalis corniculata	...++..+.....+....++.|...+.|.+m.1|+.+.+
Paspalum scrobiculatum	.....1.+..+1.1+....|.....|b....|a....
Oenothera tetraptera	..++.....+.....|.....|r....|.....
Tolpis capensis	...+.....+...|.....|.....|....+
Verbena brasiliensis	.....m.....++|.....|..++.|...+.
Lactuca inermis	.....+.....|1.+..|.r.+.|r.++.
Chamaesyce prostrata	.....a.....r.....|.....|1..+.|.....

refinements were made using the programme MEGATAB Version 2.03 (Hennekens 1996a). Ordination of the relevés was done by Correspondence Analysis (CA) using the program CANOCO (Ter Braak 1987), Version 3.1 updated in 1991.

The plant species nomenclature principally follows Arnold and de Wet (1993), but was updated according to the October 1996 version of the checklist of the PRECIS database system (National Botanical Institute, Pretoria). All plant species names were included into the South African version of TURBOVEG as operated at the Department of Botany, University of Pretoria. The formal description of the new syntaxa follows the Code of Phytosociological Nomenclature (Barkman *et al.* 1986).

Results and Discussion

Classification of plant communities

Because the vegetation data represents only relatively young abandoned fields, it is not surprising that all the recorded species are herbaceous plants. Most of them are considered to be weeds or to prefer disturbed habitats. All the studied sites showed signs of heavy grazing pressure by domestic animals, one of the biggest problems in Transkei. The TWINSPAN classification and further refinements by MEGATAB revealed three communities, interpreted as associations, one with two sub-associations, while two other communities, recognised but undersampled are not included in Table 1:

1. *Richardio brasiliensis–Eragrostietum planae*
2. *Trichoneuro grandiglumis–Aristidetum congestae*
3. *Tageto minutae–Cynodontetum dactyli*
   3.1 *cyperetosum esculenti*
   3.2 *typicum*
4. *Aristida junciformis* old fields
5. *Hyparrhenia hirta* old fields

Community 1: *Richardio brasiliensis–Eragrostietum planae* ass. nova hoc loco
Nomenclature type: Table 1, relevé 20
This community is representative of very old-fields, last cultivated much more than 5 years ago. The localities of this vegetation type are situated within the Moist Upland Grassland at altitudes between 650 and 1 500 m and having mean annual rainfall ranging between 600 and 1200 mm. Mudstones and sandstone, shales and alluvial sandstones are the most common rocks supporting partially hydromorphic, shallow to moderately shallow, sandy, grey soils but also on duplex soils typical of the habitats of the *Richardio brasiliensis–Eragrostietum planae*.

Of the differentiating species listed in species group A (Table 1) the dominants are *Richardia brasiliensis* and *Eragrostis plana*. Other diagnostic species include *Eragrostis capensis*, *Helictotrichon turgidulum*, *Microchloa caffra* and *Polygala ohlendorfiana*. This vegetation type is never dominated by *Themeda triandra*, but in the course of succession *Themeda triandra* may establish in this community (releves 2 and 20). Late successional species, such as *Sporobolus africanus*, *Eragrostis cuvula* and especially *Hyparrhenia hirta* are becoming established in this vegetation, and may gain dominance at sites where cultivation was abandoned long ago.

Community 2: *Trichoneuro grandiglumis–Aristidetum congestae* ass. nova hoc loco
Nomenclature type: Table 1, relevé 28
This community was clearly distinguished from all other communities. It was found on sandy dry soils in areas with a relatively low mean annual rainfall (500–800 mm) and at higher altitudes (1 050–1 450 m). This community inhabits a totally different habitat and is not a part of the successional coenocline spanned by the Communities 1 and 3. The *Trichoneuro grandiglumis–Aristidetum congestae* does not have *Eragrostis plana* and *Richardia brasiliensis*, both dominants of the *Richardio–Eragrostietum*. The only species regularly found to be common to the communities was *Cynodon dactylon*. The annuals *Aristida congesta* and *Trichoneura grandiglumis* are regularly found in dry grasslands and karoo, and the perennial *Eragrostis lehmanniana* is an important climax grass in both karoo and Kalahari sandy grasslands. The presence of karroid dwarf shrubs *Felicia muricata* and *Walafrida densiflora* emphasize the drought-tolerant character of this plant community.

Community 3: *Tageto minutae–Cynodontetum dactyli* ass. nova hoc loco
Nomenclature type: Table 1, relevé 39
This is a pioneer community found on relatively young old-fields (1–5 years old). It was found all over Transkei, in both Moist Upland Grassland and Coastal Grassland. The altitude varies between 700 m and 1 150 m and the mean annual rainfall ranges from 600–900 mm. The geology is mudstone, sandstone, quartzitic sandstone, and shale. Mostly red yellow/brown soils with an orthic epipedon are supported by these rocks, but also partially hydromorphic shallow to moderately shallow sandy grey soils are common. Of the species listed in group C (Table 1), *Cynodon dactylon*, *Tagetes minuta*, *Conyza bonariensis*, *Bidens pilosa* and *Schkuria pinnata* are the most prominent. The stoloniferous, clonal grass *Cynodon dactylon* is the most common dominating species. This grass species is commonly found, often as a dominant, on disturbed sites throughout South Africa. Most of the other species are weedy annual pioneers. Even though *Eragrostis plana* and *Sporobolus africanus* may be present their frequency and cover are lower.

Two sub-associations can be distinguished within the *Tageto minutae–Cynodontetum dactyli*, namely the *cyperetosum esculenti* subass. nova hoc loco (nomenclature type; Table 1, releve 34) and the *typicum* subass. nova hoc loco (the nomenclatural type is identical with that of the association). The differential species of the former sub-association include *Cirsium vulgare*, *Cyperus esculentus*, *Stenotaphrum secundatum* and *Galinsoga parviflora* (species group Ca in Table 1). The sub-association *typicum* (Table 1, releves 36–40) occurs at altitudes from 850–1 150 m, in areas characterized by yearly rainfall ranging from 600–1 400 mm.

Community 4: *Aristida junciformis* old fields
Plant communities dominated by *Aristida junciformis* are likewise disturbed, for example, the *Heteropogon contortus–Aristida junciformis* Grassland described by Eckhardt *et al.* (1996) from northern Kwazulu-Natal. Moll (1965) also considers these grassland as secondary. *Aristida junciformis* grasslands are widespread and often dominant in Transkei and Kwazulu-Natal, especially in Ngongoni Veld and Natal Mist Belt Ngongoni Veld (Acocks 1988). Acocks (1988) is of the opinion that *Aristida junciformis* replaced *Themeda triandra*-dominated veld, which in turn replaced the forests of this region. Large areas of the Short Mistbelt Grassland (Low & Rebelo 1996) have been disturbed by intensive agriculture, and here *Aristida junciformis* is dominant (Granger & Bredenkamp 1996).

A typical relevé representing this community is:
Rel. TV33: Eastern Cape Province, Transkei, between Lundini and Mhlwazini.
Latitude (degr./min/sec): 31–12–22
Longitude (degr./min/sec): 29–49–00
Altitude (m): 0660
Aspect (degrees): 360.0
Slope (degrees): 3

Cover total (%): 95
Cover herb layer (%): 95
Aver. height (high) herbs (cm): 30
Aver. height lowest herbs (cm): 2
Maximum height herbs (cm): 100

Aristida junciformis	5	*Digitaria ternata*	+
Eragrostis plana	4	*Eragrostis capensis*	+
Paspalum scrobiculatum	2a	*Gnidia* sp.	+
Sporobolus africanus	2a	*Helichrysum subglomeratum*	+
Ihildgaardia ovata	1	*Hibiscus* sp.	+
Spermacoce natalensis	1	*Kyllinga* sp.	+
Hysterarpus sp.	+	*Lactuca inermis*	+
Aristea sp.	+	*Zornia capensis*	+
Cynodon dactylon	+		+

Community 5. *Hyparrhenia hirta* old fields
This plant community on old-fields dominated by *Hyparrhenia hirta*, represents a vegetation type in its own right. It is closely related to the *Eragrostis plana–Sporobolus africanus* Grassland, a species poor, disturbed grassland that occur throughout Kwazulu-Natal (Eckhardt *et al.* 1996). *Hyparrhenia hirta* dominated grassland occur widespread over Transkei and Kwazulu-Natal, and are often considered as secondary, as their origin can be related directly to man-made disturbances (Moll 1965; Rivers-Moore 1997). An example is the *Helichrysum rugulosum–Hyparrhenia hirta* low-altitude grasslands described by Eckhardt *et al.* (1996) from northern Kwazula/Natal.

A typical releve representing this community is:
Releve number TV 182: Eastern Cape Province, Transkei, Ntlabeni.
Latitude (degr./min/sec): 30–45–29
Longitude (degr./min/sec): 28–51–19
Aspect (degrees): 304.0
Slope (degrees): 7
Cover total (%): 75
Cover herb layer (%): 75
Cover moss layer (%): 5
Cover bare rock (%): 1
Aver. height (high) herbs (cm): 60
Aver. height lowest herbs (cm): 5
Maximum height herbs (cm): 70
Maximum height cryptogams (mm): 10
Geomorphology: midslope

Hyparrhenia hirta	5	*Crabbea nana*	+
Lobelia erinus	2m	*Eragrostis plana*	+
Aristida junciformis	1	*Helichrysum callicomum*	+
Ifloga glomerata	1	*Hermannia depressa*	+
Sebaea leiostyla	1	*Indigofera* sp.	+
Senecio sp.	1	*Richardia brasiliensis*	+
Conyza bonariensis	+	*Gomphrena celosioides*	+
Tortella sp.	2a		r

Ordination

Correspondence analysis applied to the set of 40 relevés resulted in the ordination scatter diagram given in Figure 2. Since the first two ordination axes accounted for only 12% of the variance in the data, the interpretative value of the ordination is poor.

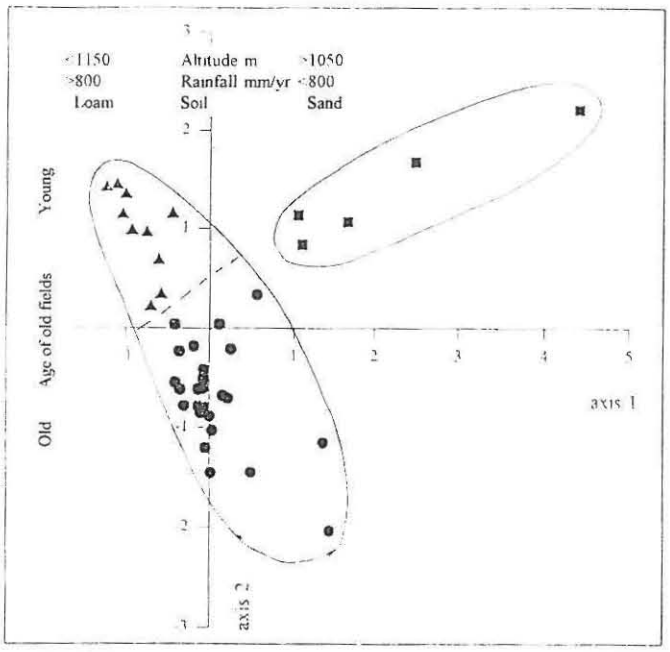

Figure 2 Ordination diagram of axes 1 and 2. Legend: full circle: *Richardio brasiliensis–Eragrostietum planae*; full square: *Trichoneuro grandiglumis–Aristidetum congestae*; full triangle: *Tageto minutae–Cynodontetum dactyli*.

However, the following interpretation is presented:

The *Trichoneuro grandiglumis–Aristidetum congestae* relevés were placed to the right and were clearly separated from the rest of the old-fields. The right hand part of the diagram represents the drier, more sandy areas at higher altitudes, thus representing a totally different ecosystem and not part of the successional coenocline. The *Tageto minutae–Cynodontetum dactyli* and the *Richardio brasiliensis–Eragrostietum planae* relevés were all placed to the left of the ordination scatter diagram, representing the moister areas at lower altitudes, mostly on loamy, hydromorphic or duplex soils. These results suggest that the first axis represents a discontinuity between the vegetation of loamy soils, moist conditions and lower altitudes and the vegetation of sandy soils, drier conditions and higher altitudes.

Axis 2 may be interpreted as a coenocline spanning from the *Tageto minutae–Cynodontetum dactyli* at the top of the diagram and representing the youngest of the old fields (abandoned 1–3 years ago) to the *Richardio brasiliensis–Eragrostietum planae* at the bottom of the diagram and representing the older old fields (last cultivated more than 5 years ago). These releves may indicate the trend of succession from the pioneer *Tageto minutae–Cynodontetum dactyli* to the more advanced stages of succession, represented by the *Richardio brasiliensis–Eragrostietum planae*.

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Appendix 1 Locations of the relevés and selected basic data on habitat, sampling scale and vegetation structure. Legend: #: the relev;e number in Table 1; TV: the unique relevé number in the data-base in Pretoria. Lat: latitude in degr./min/sec; Long: longitude in degr./min/sec; VT: vegetation type according to Low & Rebelo (1996); Asp: aspect in degrees; Slope: slope of the plot (%); Area: sampled plot size in sp.m; AV: average height of the vegetation (cm); Cov: total cover of the vegetation (%); # sp.: no. of taxa in the relevé

#	TV	Lat	Long	VT	Asp	Slope	Area	Cov	Av	# sp.
1	4226	304448	285114	42			25	60	50	23
2	50209	301657	282449	42	135	5	100	60	10	24
3	4227	302925	283500	42			25	50	2	20
4	50241	313259	284834	42	270	2	25	90	15	15
5	4188	314923	275253	42			100	80	50	17
6	4189	321032	275646	42	270	5	25	90	40	27
7	4195	320933	281547	42	78	5	25	90	25	22
8	4197	315700	282150	42	52	7	25	95	30	24
9	4201	314838	283535	42			100	97	10	21
10	4203	311455	283829	42	90	2	25	90	15	14
11	4204	311445	283827	42	90	3	100	65	10	18
12	4205	311455	283829	42	135	4	25	80	30	13
13	4206	311501	283838	42	135	2	25	60	35	12
14	4216	314237	275750	42	45	4	25	70	5	12
15	4218	314929	283356	42	45	2	25	60	12	15
16	4220	305540	293513	42	157	5	25	95	30	15
17	4228	313403	290522	42	45	2	25	70	15	13
18	4229	311228	283651	42	270	11	25	65	70	36
19	50173	304812	292314	42	164	7	25	85	20	11
20	50233	313110	285129	42	250	1	24	85	30	19
21	4190	313722	284351	42	45	4	100	50	20	23
22	50208	301812	282622	42	315	5	25	70	25	15
23	4207	313722	284402	42	270	7	100	70	15	30
24	4225	304514	285114	42			25	80	15	22
25	50191	301758	283151	42	128	2	25	90	50	20
26	4193	313329	272443	42			28	70	35	20
27	4217	314040	272044	42			25	50	5	10
28	4224	314235	265731	42			100	75	3	14
29	4223	314439	265710	42			100	85	15	17
30	50195	302917	293506	42	120	3	100	45	10	15
31	4200	314839	283530	42			25	85	20	21
32	4202	314012	284225	42	320	10	30	80	25	28
33	50151	305151	293509	42	86	10	64	80	50	26
34	4198	315004	283254	42			25	90	8	28
35	50148	305104	294255	42	135	10	25	80	10	18
36	4191	314901	285251	42			25	60	25	19
37	4208	314012	284226	42	315	8	25	65	6	20
38	50123	305901	300044	48	180	0	25	90	15	18
39	50133	304240	292655	42	45	3	25	60	10	18
40	4230	313010	285515	42	270	3	25	60	35	18